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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/785,178	02/25/2004	Jong-Heui Song	9862-000020/US	7416

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EXAMINER	
NGUYEN, HA T	
ART UNIT	PAPER NUMBER
2812	

DATE MAILED: 10/18/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/785,178	SONG ET AL.	
	Examiner	Art Unit	
	Ha T. Nguyen	2812	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *03 August 2005*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-18* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-18* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

ETAILED ACTION

Notice to applicant

1. Applicants' Amendment and Response to the Office Action mailed 5-4-5 has been entered and made of record.

Claim Rejections - 35 USC '§ 103

1a. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 1038 and potential 35 U.S.C. 102(f) or (g) prior art under 35 U.S.C. 103(a).

2. Claims 1-7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Brooks et al. (USPN 5786276, hereinafter "Brooks") or Zhu et al. (USPAPN 2002/0182880, hereinafter " Zhu ").

Referring to Figs. 1-6 and related text, Brooks discloses [Re claim 1] a method of etching a silicon nitride film comprising; forming a buffer layer of silicon dioxide 123 on a semiconductor substrate 122; forming a silicon nitride film 125 on the buffer layer; heating the semiconductor substrate to a process temperature in the range of 20-100C and etching the silicon nitride film using a plasma generated from an etching gas including CH_2F_2, while maintaining the semiconductor substrate at the process temperature and wherein the etching gas

has an etching selectivity of above about five between the silicon nitride and the buffer layer at the process temperature; [Re claim 2] wherein the etching gas further includes CF_4; [Re claim 3] wherein the etching gas further includes argon; [Re claim 4] wherein the etching gas further includes O_2; and [Re claim 5] wherein the etching gas includes a mixture of CH_2F_2, Ar and one gas selected from a group consisting of CF_4 and O_2, and further wherein; the plasma etches silicon nitride at a first etch rate; the plasma etches silicon dioxide at a second etch rate; and a ratio of the first etch rate to the second etch rate is at least 5:l; [Re claim 6] wherein the process temperature is between about 60 and about 100 C; (See Summary, col. 4, lines 31-37, col. 7, lines 15-23 and par. bridging cols. 9-10); [Re claim 7] wherein: etching the silicon nitride film includes: loading the semiconductor substrate on which the silicon nitride film has been formed onto a supporting plate within an etching chamber; heating the semiconductor substrate to the process temperature by heat transfer from the supporting plate; and introducing the etching gas into the etching chamber and applying RF power to the etching gas to form the plasma within the etching chamber (see col. 4, lines 19-37, col. 5, lines 6-20, and col. 6, line 55-col. 7, line 24). But it fails to disclose the exact claimed range. However, in the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a *prima facie* case of obviousness exists (See MPEP 2144.05).

Referring to Figs. 6A-6F and related text, Zhu discloses [Re claim 1] a method of etching a silicon nitride film comprising; forming a buffer layer of silicon dioxide 320 on a semiconductor substrate; forming a silicon nitride film 318 on the buffer layer; heating the semiconductor substrate to a process temperature in the range of 0-100C and etching the silicon nitride film using a plasma generated from an etching gas including CH_2F_2, while maintaining the semiconductor substrate at the process temperature and wherein the etching gas has an etching selectivity of above about five between the silicon nitride and the buffer layer at the process temperature; [Re claim 2] wherein the etching gas further includes CF_4; [Re claim 3] wherein the etching gas further includes argon; [Re claim 4] wherein the etching gas further includes O_2; and [Re claim 5] wherein the etching gas includes a mixture of CH_2F_2, Ar and one gas selected from a group consisting of CF_4 and O_2, and further wherein; the plasma etches silicon nitride at a first etch rate; the plasma etches silicon dioxide at a second etch rate; and a ratio of the first etch rate to the second etch rate is at least 5:l ; [Re claim 6] wherein the process

temperature is between about 60 and about 100 C; (See Table 2, pars. 42-46 and 49); [Re claim 7] wherein: etching the silicon nitride film includes: loading the semiconductor substrate on which the silicon nitride film has been formed onto a supporting plate within an etching chamber; heating the semiconductor substrate to the process temperature by heat transfer from the supporting plate; and introducing the etching gas into the etching chamber and applying RF power to the etching gas to form the plasma within the etching chamber (see pars. 38-44). But it fails to disclose the exact claimed range. However, in the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a *prima facie* case of obviousness exists (See MPEP 2144.05).

Therefore, it would have been obvious to Brooks' teaching to obtain the invention as specified in claims 1-7.

3. Claims 8-12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Buynoski et al. (USPN 6300203, hereinafter " Buynoski ") in view of Brooks or Zhu.

Referring to Figs. 8-12 and related text, Buynoski discloses a method of manufacturing a semiconductor device comprising: forming a gate insulation film 106 on a semiconductor substrate 102; forming a gate structure having a gate electrode 108 and a gate mask 110 on the gate insulation film, forming a first buffer layer 112 including silicon oxide on the gate structure and inherently on the semiconductor substrate; forming a silicon nitride film on the first buffer layer to form a gate spacer along a sidewall of the gate structure.

But it fails to disclose expressly the details about the etching of the silicon nitride layer.

However, the missing limitations are well known in the art because Brooks or Zhu discloses these features, as shown above.

A person of ordinary skill is motivated to modify Buynoski with Brooks or Zhu to obtain effective etching of silicon nitride.

Therefore, it would have been obvious to combine Buynoski with Brooks or Zhu to obtain the invention as specified in claims 8-12 .

4. Claims 13-18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Buynoski in view of Brooks or Zhu, as applied above, and further in view of Tseng (USPN 5733808).

The combined teaching of Buynoski and Brooks or Zhu discloses substantially the limitations of claims 13-18, as shown above. It also discloses forming an etch stop layer 120 on the gate structure, the gate spacer and the semiconductor substrate, the etch stop layer including silicon nitride; forming an interlayer insulation film 122 on the etch stop layer.

But it fails to disclose expressly forming a second buffer layer on the gate structure, the gate spacer and the semiconductor substrate, the second buffer layer including silicon oxide; removing the interlayer insulation film from a contact hole region, thereby exposing a region of the etch stop layer; removing the exposed region of the etch stop layer with a second plasma generated from a second etching gas that includes CH_2F_2 while maintaining the semiconductor substrate at the second process temperature thereby exposing a region of the second buffer layer; removing the exposed portion of the second buffer layer to expose a region of the semiconductor substrate and form a contact opening, and other details about the first and second etching steps.

However, the missing limitations are well known in the art because Tseng discloses the forming of a second buffer layer 16 and a contact hole through the second buffer and the etch stop layer 18 (See Fig. 1 and col. 4, lines 51-67). In the combined teaching of Buynoski and Brooks or Zhu and Tseng, the silicon nitride layer and the etch stop layer are etched in the conditions as claimed.

A person of ordinary skill is motivated to modify Buynoski and Brooks or Zhu with Tseng to obtain reliable connection to the semiconductor substrate.
Therefore, it would have been obvious to combine Buynoski and Brooks or Zhu with Tseng to obtain the invention as specified in claims 13-18 .

Response to Amendment

5. Applicants' arguments with regard to the rejections under 35 U.S.C. 103 have been fully considered, but they are not deemed to be persuasive for at least the following reasons.

Applicants argued that Brooks discloses an overlapping range that is too broad. The examiner disagreed. The overlapping range 20-100C covers most of the claimed range of at least about 40C cannot be considered too broad.

Applicants argued that Zhu mentions a range of 0 to 100C only as an example, not a process temperature. The examiner disagreed, Zhu discloses that the substrate temperature is

maintained below 140C and gives an example of 0 to 100C, this cannot be considered anything but the process temperature. Besides, the arguments concerning the etch rate is irrelevant since this is not a recited limitation.

Applicants argued that the examiner misinterpreted the teaching of Buynoski because the examiner used the prior art portion of the Buynoski reference. The examiner disagreed, whether the portion used is in the prior art portion or not this is immaterial because it does show the claimed invention is well known in the art. Besides, the arguments about the gate insulation layer being of low or high K are deemed irrelevant since this is not claimed.

Therefore, the applied references do teach or make obvious all the limitations of the rejected claims 1-18.

Conclusion

6. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for response to this final action is set to expire THREE MONTHS from the date of this action. In the event a first response is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event will the statutory period for response expire later than SIX MONTHS from the date of this final action.

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ha Tran Nguyen whose telephone number is (571) 272-1678. The examiner can normally be reached on Monday-Friday from 8:30AM to 6:00PM, except the first Friday of each bi-week. The telephone number for Wednesday is (703) 560-0528.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael S. Lebentritt, can be reached on (571) 272-1873. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Ha Tran Nguyen
Primary Examiner
10- 14- 05